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A topic modeling approach

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Fictional expectations and the global media in the Greek debt crisis: A topic modeling approach

Volker Daniel, Magnus Neubert, Agnes Orban

Abstract

We study the role of global media during the Greek debt crisis and relate it to the transmission of events on financial actors' expectations. To identify news coverage about the Greek debt crisis, we apply topic modeling to a newly compiled dataset of over 430,000 articles from The International New York Times and Financial Times from 2009 to 2015. We identify a Greek debt crisis topic and relate it to events concerning Greece during this time period. Our finding is that events are only relevant for financial markets when they are covered in the media, whereas events without media coverage have no effect. News coverage without immediate events is equally irrelevant for financial markets.

Keywords: Greek Debt Crisis, Machine Learning, Topic Models, Expectations, Economic Sociology, Big Data, Financial Crises, Media

JEL Classification: D84; Z13; C55; G01; L822

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1 Introduction

Expectations on financial markets permanently update with each new situation and under changing conditions. The media seem to play a crucial role in influencing expectations about future states: They inform about events and stories, highlight certain aspects and create their own images and narratives. They influence financial actors' expectations through both information and narration. According to the sociologist Jens Beckert, the mass media provide a forum for financial market analysts to constitute and maintain investors' expectations regarding the future value of financial securities.[1]

But did stories and news in the global media matter in the development of the Greek debt crisis since 2009? Beckert states that shocks like Mario Draghi's famous expectation "and believe me it will be enough" influenced credit conditions of countries like Portugal and Greece to a large part by the immediate transmission to financial markets via the mass media.[2] While economic fundamentals remained unchanged, Mario Draghi created a new, alternative image of the future that prevailed for two reasons. First, owing to his position as head of the European central bank, Draghi had the instruments of monetary policy at his disposal necessary to take adequate measures. Second, the knowledge that the speech was transmitted by the global mass media to the global public made it a more effective tool for Draghi to create a new prospect of the future and added credibility to his statement in the eyes of the audience. While it is clear that important speeches of powerful people are often attributed relevance in many areas, it is the media that highlight this relevance and inform the recipients immediately and globally, and which then react to a new outlook of the future. The media's selection also signals importance. Draghi's speech, together with the media coverage about it, created a new image among economic agents and thus provoked actions on financial markets. This episode points to the relevance of the media for the transmission of events to financial markets during the Greek debt crisis. The reactions to the speech would have supposedly been different with a different type, tone or narrative of media coverage. Observing a wide array of events, it would, however, be important to generalize the role of the media in the process of shaping financial expectations.

In this article, we propose a quantitative measure of media coverage as a way to capture the impact of the media, which we then relate to financial markets' expectations. For this purpose, we first quantitatively

[1] *J. Beckert*, Imagined futures: fictional expectations and capitalist dynamics. Harvard University Press, 2016. p. 91.
[2] *J. Beckert*, Woher kommen Erwartungen?, MPIfG Discussion Paper 17/17, 2017, p 11.

analyze coverage about the Greek debt crisis in the global media. We apply the novel approach of topic modeling to a newly compiled large dataset of over 430,000 newspaper articles from *The International New York Times* and *Financial Times* over the period from 2009 to 2015.[3] This is one of the largest datasets of news articles to which topic models have been applied thus far. By topic models, we classify the text data into a total number of 200 topics. We identify a single topic that clearly relates the country of Greece to financial terms and crisis terms and thus represents news coverage about the Greek debt crisis in global newspapers. We read a large number of articles with a high share of the topic and conclude that the Greek debt crisis topic series contains sufficient information to act as a proxy for global news coverage about the Greek debt crisis. We propose this proxy as a quantified factor of the mass media of financial actors' expectations.

Next, we compare the Greek debt crisis topic share over time with a timeline of events of the Greek debt crisis. We relate a majority of events during the crisis to dates with high news coverage. We find some events without news coverage in the global newspapers, and some dates with news coverage but without events. We then test the effect of events and news coverage about the Greek debt crisis on financial markets.

Our finding is that events are only relevant for financial markets when they go along with media coverage. Our measure of media coverage of the Greek debt crisis is positively correlated with financial markets' expectations, for which we use the interest rate on Greek bonds as a proxy. Events that are covered in the news entail significant changes on financial markets. We find no such effect for news without media coverage. Our finding that only events covered in the media entail an effect on financial markets while other events do not, points to our hypothesis that financial markets indeed depend on media coverage.

This finding suggests an "information effect" of media. The media inform financial markets about relevant events, that otherwise would have not reached them. We find a relevant information effect when classifying dates into "good news" and "bad news" for Greece. We further propose examining a possible "narration effect" of media, namely the impact that the media have by narrating stories beyond the pure facts and new information. We achieve this by testing the effect of dates with high news coverage, but without events on the Greek interest rate. We find no effect of such dates.

[3] Topic Modeling has been proposed to analyze large text datasets by *D. Blei/ A. Y. Ng/ M. I. Jordan*, Latent Dirichlet Allocation, Journal of Machine Learning Research 3, 2003, pp. 993–1022.

2 Theory

The question of whether the media have an impact on financial markets has been broadly discussed in the economic and financial literature.[4] This literature treats the media typically as a provider of information and creator of sentiments to identify information shocks by media coverage. In this article, we focus on mass media as a transmission mechanism between real-world events in the Greek debt crisis and financial markets.

The mass media produce biases according to their rationality. According to Luhmann, mass media select by the code information/non-information and not by truth/non-truth.[5] This implies that the mass media focus on discontinuities, quantities and conflicts. Mass media thus report about events rather than complex processes. In addition to the highly selective image of the world which the mass media sketch, they frame the information and thus bias the image. On the one hand, they refer to past events and embed them into a narrative context. On the other hand, the expression of opinions regulates meaning and interpretation of events before and after their occurrence. Such opinions also frame events and keep stories in the news. The source of opinion must have a remarkable reputation qua position or person, but frequent citations in mass media also strengthen the reputation of the source.[6]

There are also more hidden selection manners: categorization as describing specific issues in general terms and causal attribution. The latter describes the causes and consequences of a phenomenon by picking particular causes/consequences and excluding other causes/consequences or causes of the causes or consequences of the consequences. As a result, it is impossible for mass media to reflect the world in a complete and unbiased way.[7] Luhmann states: "The description of the world and of society to which modern society orients itself within and outside the system of its mass media arise as a factual effect of this circular permanent activity of generating und interpreting irritation through information tied to a particular moment (that is, as a difference which makes a difference)."[8] Hence, mass media's biased and

[4] See for example *A. Groß-Klußmann/ N. Hautsch*, When machines read the news: Using automated text analytics to quantify high frequency news-implied market reactions, Journal of Empirical Finance, Vol. 18, No. 2, 2011, pp. 321–340; *P. C. Tetlock*, Giving content to investor sentiment: The role of media in the stock market, Journal of Finance, Vol. 62, No. 3, 2007, pp. 1139–1168; *T. P. Wisniewski/ B. Lambe*, The role of media in the credit crunch: The case of the banking sector, Journal of Economic Behavior and Organization, Vol. 85, No. 1, 2013, pp. 163–175.
[5] *N. Luhmann*, The reality of the mass media, Standford University Press, 2000, pp. 17-19.
[6] *Ibid.* pp. 28-35.
[7] *Ibid.* p. 77. It should be noted that in line with Luhmann's radical constructivism nobody has an unbiased perception of the reality.
[8] *Ibid.* p. 98.

selected coverage generates resonance to its environment, which may become the subject of future coverage. Thus, this constructed present guaranteed by mass media is given for all function systems and individuals in society. Based on this reality, the function systems and individuals create their expectations.[9]

This leads us to Jens Beckert's theory of fictional expectations.[10] Fictional expectations imply that all knowledge about the present cannot tell us anything about the future, because the future is open and contingent. Expectations about the future are fictional in the sense that we imagine how the circumstances could be and then act *as if* this imagined future will happen. Such fictional expectations motivate the action of all individuals and are also contingent. Therefore, expectations can become objects of powerful agents' attempts to shift the future in their favor. But shaping of expectation on a large scale is not possible without the mass media. To effectively reach public expectations news need to be covered by the media. With respect to financial markets, an important factor is credibility. As Beckert argues, creditworthiness is at the center of investors' decisions. Since narratives are spread by the mass media to a larger public, the media can play a crucial role in the translation of rumors and threats to financial markets. Financial actors then act in anticipation of other actors knowledge given the assumed information set based on media reports.[11]

As Robert Shiller stresses, the media and financial markets practically maintain a mutual loving relationship: The media loves financial markets because markets constantly provide new *numbers* as reactions to shocks and anticipated events. Investors read and refer to news events (events that are covered in the media) when making their investment decisions. Investors take decisions according to new information, as well as narratives about prospected high profits and low risks in the future. Such narratives are regularly taken from reports in the global media, partly because commonly-available information allows anticipating the interpretations of other actors. The media however, is likewise dependent on potentially influential agents, that provide the media's reports with a certain degree of credibility.[12]

With respect to Greece, the way in which the media covered the debt crisis potentially influenced financial markets beyond the sole information about actual events. News reports about Greece, particularly the selection of events covered and the way in which the crisis and the country of Greece were communicated

[9] *Ibid.* p. 99.
[10] *J. Beckert*, Capitalism as a System of Expectations, *Politics & Society*, Vol. 41, No. 3, 2013, pp. 323–350; *J. Beckert*, Capitalist Dynamics Fictional Expectations and the Openness of the Future, MPIfG Discussion Paper, Vol. 14/7, 2014; *J. Beckert*, Imagined futures: fictional expectations and capitalist dynamics. Harvard University Press, 2016.
[11] *Beckert*, *Imagined futures, pp.* 119-129.
[12] *R. Shiller*, Irrational Exuberance, 3rd edition Princeton University Press, 2015, pp. 108-110.

in media reports, presumably shaped investors' expectations. The many news articles potentially shaped the perception about Greece so drastically that Greece was assigned the image of a suspicious third world country.[13] The long sequence of negative events in the period from 2009 to 2012 then further cultivated the image of a failed state at Europe's periphery.

Following this line of reasoning, it is useful to empirically examine the role that media coverage plays in informing about events and contributing to the narration. With respect to information, it seems plausible that the media plays an important role in transmitting the relevant news and events to financial markets, while potentially overlooking the less important news. Hence, the events that the media informs about matter for financial markets. Other events are, however, filtered out by the media and therefore cannot update the set of information financial actors have. A possible coverage selection may occur in anticipatory obedience as part of the mutual loving affair between the two. We would also expect a resonance on financial markets due to the media's selection bias described by Luhmann. An event not transmitted by the media would not be perceived as new information. For the Greek debt crisis, we thus propose the following hypothesis:

Hypothesis 1: *Events are transmitted to financial markets via the media. Events covered in the media affect financial markets, while events not covered in the news do not affect financial markets.*

With respect to narration, it is important to disentangle the impact of media coverage from the possible *distorting* effects of events. Both may play a role at the same time. However, if the media should affect financial expectations apart from the informing actors, we should observe a reaction after media reports without actual events. Our second hypothesis is therefore:

Hypothesis 2: *Narration matters. Financial markets react to media coverage about the Greek debt crisis on dates without events.*

[13] Which may be in the sense of *R. J. Shiller*, Narrative economics, American Economic Review, Vol. 107, No. 4, 2017, pp. 967–1004.

3 Topic models – a quantitative measure of global media coverage

In order to analyze the effect of news coverage about the Greek debt crisis in global media, we make use of the novel method of topic modeling.[14] Topic models allow classifying large text datasets into topical content categories. We compare the discovered topics and identify a Greek debt crisis topic. Furthermore, we cumulate the probabilities of this topic to obtain a quantitative measure of the news coverage about the Greek debt crisis in global newspapers.

3.1 Topic Models

Topic modeling has a number of advantages over conventional text analysis techniques. It allows a broad overview of large text corpora and discovers the main themes in a collection of text data. By this, we are able to make comparisons between texts and collections without ever being able to read through all of them - not to mention manually analyze or codify them. For our purpose, it allows us to identify news articles about the Greek debt crisis in a large corpus (e.g. a text dataset) of over 430,000 articles. We are further able to employ topic probabilities from the topic model as a quantifiable measure of the extent of news coverage in articles over time.

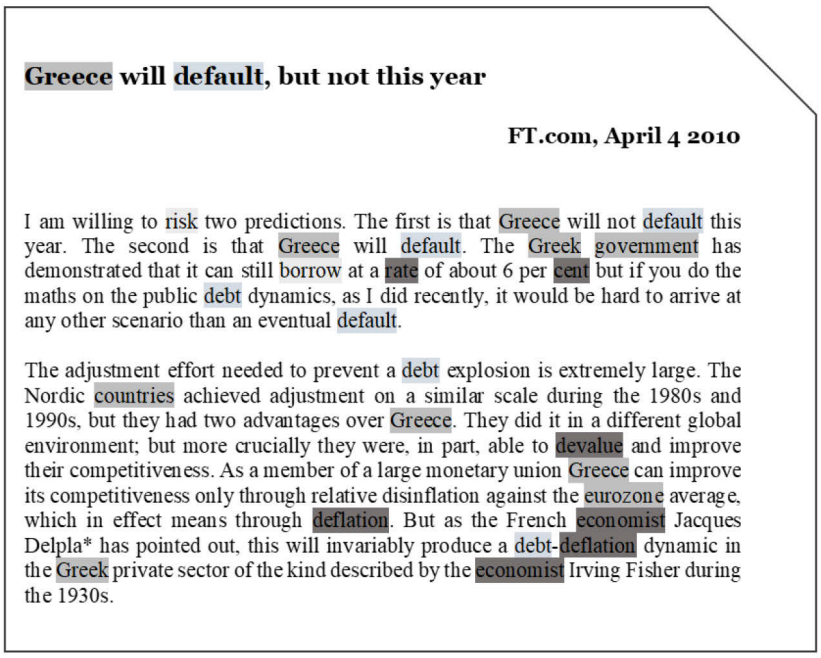
Another benefit of topic models is that we impose no restrictions on the words or documents. We do not search for particular terms like “Greek”, “debt” and “crisis” within our dataset of articles. Such a search for particular phrases could potentially miss articles that *only* talk about “Athens”, “credit” and “bailout”. Instead, topic models reveal the distinct relation of all words within all documents in the text collection. In each topic some words occur relatively more often together than other words. By this assumption, we identify whole groups or even all words in our vocabulary to contain a particular topical content. With respect to our research question, various word combinations from the fields of “Finance”, “Greece”, and “Crisis” point to topical content related to the Greek debt crisis. [15]

One way to apply topic models is via the statistical model referred to as latent Dirichlet allocation (LDA). In order to apply LDA, we assume that documents are mixtures of topics. A topic is a distribution over

[14] *Blei et al.*, Latent Dirichlet Allocation, pp. 993–1022.
[15] *D. M. Blei/ J. D. Lafferty*, Topic Models. CRC Press, 2009; *D. Blei*, Probabilistic Topic Models, Communications of the ACM, Vol. 55, No. 4, 2012, pp. 77–84.

terms (or words). Each term has a probability in each topic. Some terms occur relatively more often together in some documents than other terms. This translates into higher probabilities of such terms in the same topic.[16]

Figure 1: Article with topics highlighted by colors



Greece will default, but not this year

FT.com, April 4 2010

I am willing to risk two predictions. The first is that Greece will not default this year. The second is that Greece will default. The Greek government has demonstrated that it can still borrow at a rate of about 6 per cent but if you do the maths on the public debt dynamics, as I did recently, it would be hard to arrive at any other scenario than an eventual default.

The adjustment effort needed to prevent a debt explosion is extremely large. The Nordic countries achieved adjustment on a similar scale during the 1980s and 1990s, but they had two advantages over Greece. They did it in a different global environment; but more crucially they were, in part, able to devalue and improve their competitiveness. As a member of a large monetary union Greece can improve its competitiveness only through relative disinflation against the eurozone average, which in effect means through deflation. But as the French economist Jacques Delpla* has pointed out, this will invariably produce a debt-deflation dynamic in the Greek private sector of the kind described by the economist Irving Fisher during the 1930s.

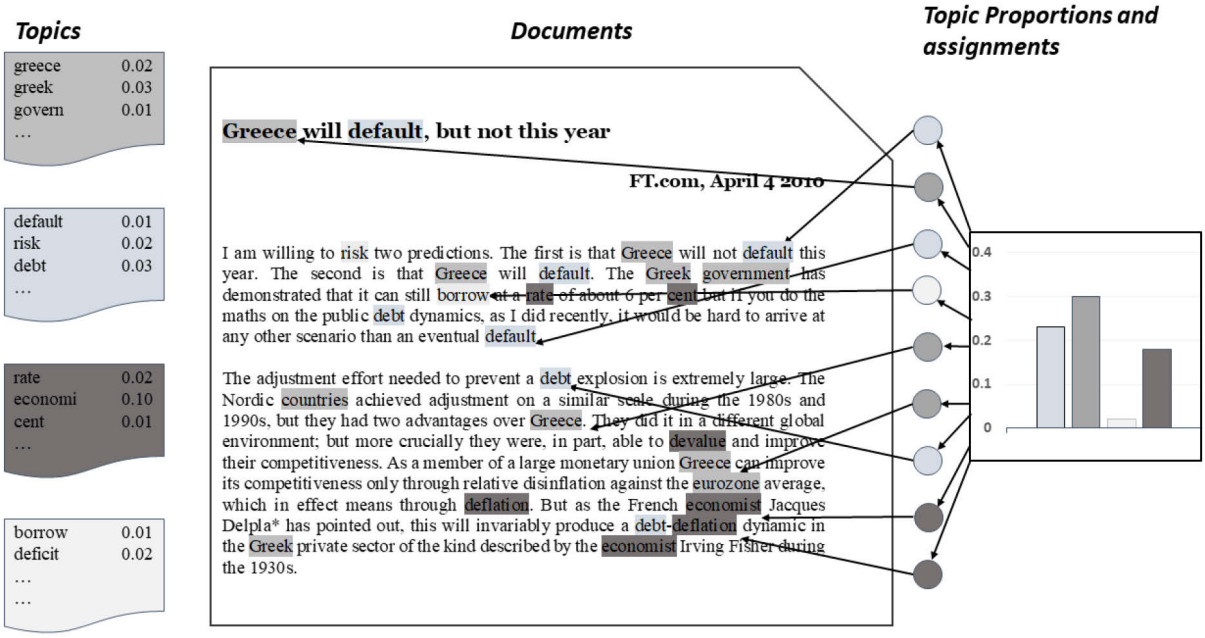
Financial Times, April 4th, 2015. Hypothetical topics highlighted by colors (added by the authors).[17]

Figure 1 provides an example of topics in a document. The text is an opinion article concerned with the Greek debt crisis taken from the *Financial Times* from April 4th, 2012. We highlighted four topics in four different shades of gray (from dark to light: dark gray; gray; light gray; very light gray). For instance, the dark gray topic comprises the words “economy”, “devalue” and “deflation”. The gray topic comprises the terms “Greece”, “Greek”, “minister” and “government” etc. Given the words in each topic, we could denote each topic by a meaningful name: dark gray topic = “economy”, gray topic = “Greece”, light gray topic = “debt”, very light gray topic = “risk”.

[16] *Blei et al,* Latent Dirichlet Allocation.
[17] Figure related to *Blei*, Probabilistic Topic Models.

Regarding the document-generating process, we assume that an author who writes a document first chooses the proportion of topics to be included in the text. We can imagine that the choice of topic proportions is determined by what the author intends to write about. The author then creates the text by drawing words from the topic distributions given the probability of each word in each topic and the author's desired topic proportions in the document. We further assume that the topic distributions exist before the author begins to write. Accordingly, they are known to the author and are independent from the author's decisions about the topics in the document.

Figure 2: The document-generating process: Topic distributions (left), documents with color-coded topics (center) and the topic proportion of the text (right)

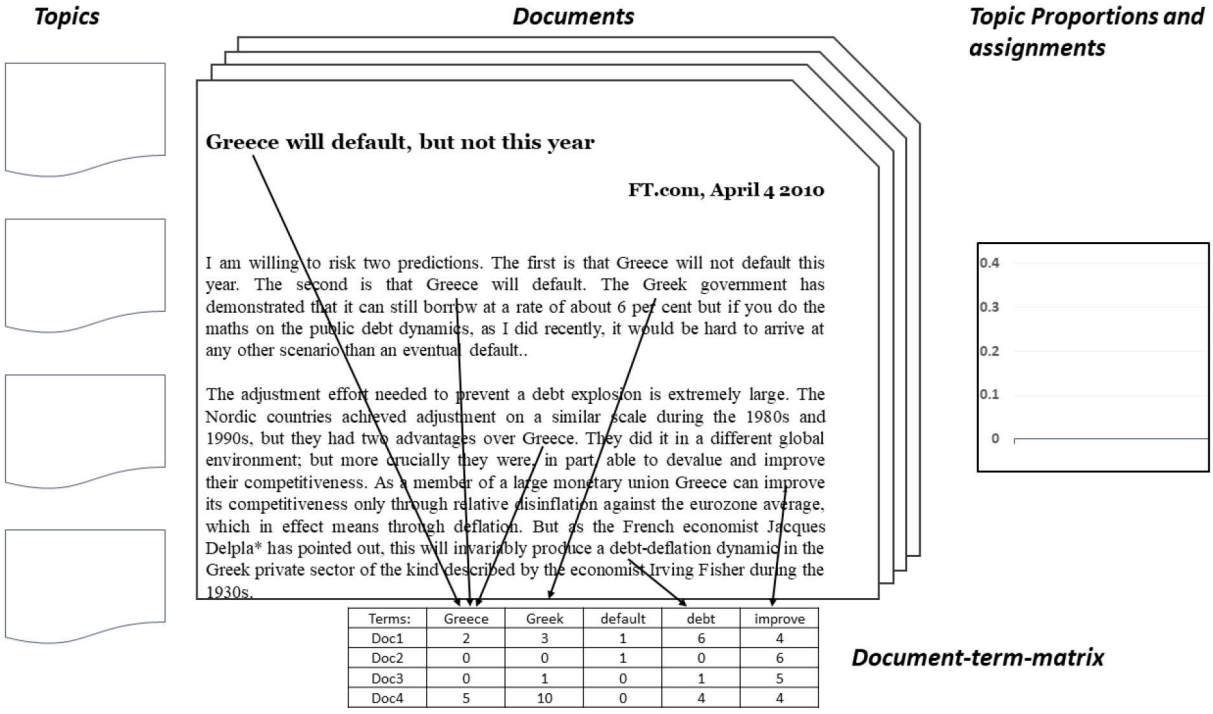


Left-hand side: exemplary topic distributions of four topics; middle: exemplary document with topics highlighted by colors; right-hand side: exemplary topic proportions of the document. Colored dotes represent the author's word draws according to topic distributions and proportions. The drawn words are then placed into the text. Source: Financial Times, April 4th, 2015.[18]

[18] Figure related to *Blei*, Probabilistic Topic Models.

To illustrate the process of document-generation more precisely, Figure 2 provides an overview of the hypothetical creation of the article about the Greek debt crisis discussed before. On the left-hand side, the topic distributions are denoted as lists of words ordered by probabilities. The topics exist before the article is created. Each word has a probability in each topic, whereby some words are much more likely to be part of one topic than the other. On the right-hand side, we indicate the topic proportions of the text chosen by the author. Regarding the article in the center, we could, for instance, assume, that the author had the idea to write about Greece, the debt crisis and economic affairs, before he began to write the article. Accordingly, he chose the topic proportions of the text. The author then created the text by randomly choosing words from the topic distributions given the topic proportions. In the center of Figure 2, we illustrate this process for a few topics and words by the colored dots, words and arrows. The author has chosen that the article should predominantly comprise the light gray, gray and dark gray topics. He picks words from these distributions and places them into the text.

Figure 3: LDA infers topic distributions and topic proportions solely from the words in the documents



Only the documents are observed: Topic distributions, word assignments and topic proportions need to be inferred via the LDA. The words in each document are transferred into a document-term-matrix.[19]

[19] Figure related to *Blei*, Probabilistic Topic Models.

In practice, we only observe the text documents. As illustrated in Figure 3, topics and topic proportions are not known and not visible. LDA provides a tool to infer the hidden - or *latent* - topic assignments for each word and topic proportions in each document by drawing comparisons between the documents. For this, we count all words in all documents and transfer them into a document-term-matrix (DTM) as indicated in the lower part of Figure 3. The DTM has the dimensions of the total number of documents D, and the total number of the occurring vocabulary V. Each element denotes how often a particular word occurs in a particular document. Each row of the DTM thus resembles the distribution of words in each document. We then ask: What is the best way to assign topic probabilities to words and documents given the observed distributions of words in each text? Formally, LDA estimates the following relationship between topics, proportions and assignments in the entirety of documents:

$$p(\beta_{1:k}, \theta_{1:D}, z_{1:D}, w_{1:D}) = \prod_{i=1}^{K} p(\beta_i) \prod_{i=1}^{K} p(\theta_d) \left(\prod_{i=1}^{K} p(z_{d,n}|\theta_{d,n}) p(w_n|\beta_{1:k}, z_{d,n})\right) \quad (1)$$

In Equation (1), $\beta_{1:K}$ are the K topics where each topic β_k is a distribution over the fixed vocabulary $\{1, \dots, V\}$. $\theta_{1:D}$ are the topic proportions over all documents $\{1, \dots, D\}$. For a particular document d, θ_d is the topic proportion, whereas $\theta_{d,k}$ denotes the proportion of topic k in the document d. With respect to words, $z_{1:D}$ denotes the topic assignments to the words in all documents $\{1, \dots, D\}$. For a particular document, $z_{d,n}$ denotes the topic assignment for the n^{th} word in document d. The only observables are the words in the documents, $w_{1:D}$**.** Each document is a sequence of N words: $d = (w_{d,1}, w_{d,2}, \dots, w_{d,N})$. A word is the basic unit of discrete data, defined to be an item of the vocabulary stated above.[20]

The challenge is that all distributions are unknown except for the words in each document. LDA is a way of inferring $\theta_{1:D}$, $\beta_{1:K}$ and $z_{1:D}$ conditional on the known distribution of words in the documents, $p(w_{1:D})$:

$$p(\beta_{1:k}, \theta_{1:D}, z_{1:D} | \, w_{1:D}) = \frac{p(\beta_{1:k}, \theta_{1:D}, z_{1:D}, w_{1:D})}{p(\, w_{1:D})} \quad (2)$$

The resulting distribution is the so-called *posterior* which reveals the hidden topic structure from the observed documents.[21]

[20] *Blei*, Probabilistic Topic Models, p. 80.
[21] *Ibid.* pp. 80-81.

3.2 LDA applied to the data

We apply LDA to a newly-compiled corpus of 432,172 articles published in *The International New York Times* (formerly *The International Herald Tribune*) and *Financial Times* between 2009 and 2015. [22] We choose this time period, because it comprises most and the most important events related to the Greek debt crisis starting in October 2009. Before 2009 the Greek debt crisis was not apparent as a pressing issue both in Greece, among financial analysists and in the global media. After 2015 we found considerably less news and events regarding the Greek debt crisis. Expanding our analysis to longer periods between January 2007 and December 2016 or setting the starting time to October 2009 did not alter our results.

For each document, we store the date of publication. We remove numbers, white spaces and empty lines. All letters are transformed to lower case. We stem words, namely by using the word parts to which affixes can be attached. Accordingly, we remove plurals and singular endings. Related expressions are counted as one term. For instance, the words "finance", "finances" and "financial" are converted into the stemmed term "financ". We also remove stop words (words without topical content) and rare words (words that occur fewer than 500 times in the entire corpus). The transformations result in a total number of $11{,}847$ distinct words as part of our vocabulary. We transfer the documents and vocabulary into a DTM with the dimensions $D = 432{,}172$, and $V = 11{,}847$. The transformation of the corpus reveals certain restrictions of our method. Topic models are not able to distinguish the structure, tone or sentiment of documents. That is, the method will assign the same topical content to the sentences "Merkel saves Greece" and "Greece saved Merkel" although the meaning may be fundamentally different. With respect to our aim in identifying news coverage about the Greek debt crisis, however, both sentences will likely point to information about the Greek debt crisis.

We specify LDA by the total number of topics $K = 200$. This number is in the range of the optimal number of topics according to four optimality measures that we have tested.[23] We infer topics using Gibbs sampling

[22] Articles were collected from the ProQuest and LexisNexis databases. Access via https://search.proquest.com/, http://www.lexisnexis.com/hottopics/lnacademic/.

[23] We tested according to four methods that have been proposed by (1) *R. Arun/ V. Suresh/ C. E. Veni Madhavan/ M. N. Narasimha Murthy*, On Finding the Natural Number of Topics with Latent Dirichlet Allocation: Some Observations, in Advances in Knowledge Discovery and Data Mining: 14th Pacific-Asia Conference, PAKDD 2010, Hyderabad, India, June 21-24, 2010. Proceedings. Part I, *M. J. Zaki/ J. X. Yu/ B. Ravindran/ V. Pudi*, Eds. Berlin, Heidelberg, Springer 2010, pp. 391–402; (2) *J. Cao/ T. Xia/ J. Li, Y. Zhang/ S. Tang*, A density-based method for adaptive LDA model selection, Neurocomputing, Vol. 72, No. 7, 2009, pp. 1775–1781; (3) *R. Deveaud/ E. SanJuan-Ibekwe/ P. Bellot*, Accurate and effective latent concept modeling for ad hoc information retrieval, Doc. Numérique, Vol. 17, No. 1, 2014, pp. 61–84; (4) *T. L. Griffiths/ M. Steyvers*, Finding scientific topics, Proceedings of the National academy of Sciences, Vol. 101, No. suppl 1, 2004, pp. 5228–5235.

with 1,000 iterations. To apply Gibbs sampling we further need to set the starting values – or priors – for the topic distributions over documents $\theta_{1:D}$ and the distributions over terms $\beta_{1:K}$. We follow the literature and set $\alpha_d = 50/K$ and $\eta = 0.1$.[24]

The posterior results in two outputs. First, we receive a matrix β with probabilities of each word in each topic $k = 1 \ldots 200$. This matrix is useful to relate the estimated topics to actual text content. We can order the words in each topic by probability and observe which words likely appear together in documents with a high proportion of a certain topic. Second, the matrix θ relates a probability of each topic to each document. θ specifies the topic proportions, which means the probability by which each topic occurs in each document.

Table 1: Results topic model

Topic 64	Topic 83	Topic 169	Topic 27	Topic 12
garden	econom	greec	syria	obama
tree	economi	greek	syrian	presid
mountain	polici	bailout	assad	administr
forest	fiscal	imf	regim	white
anim	govern	countri	rebel	hous
dog	growth	fund	opposit	barack
plant	countri	european	govern	american
flower	reform	financ	forc	bush
bird	deficit	govern	war	washington
natur	crisi	minist	lebanon	polici

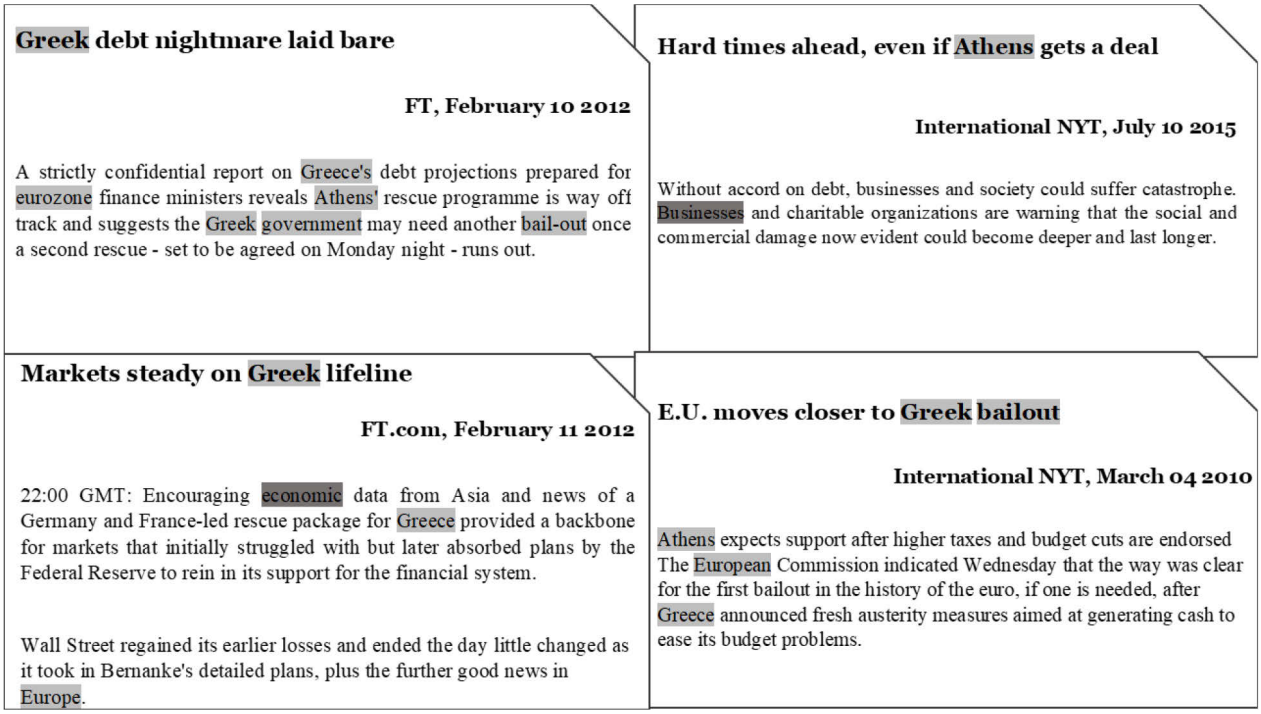
An excerpt from the matrix β. Ten terms with highest probabilities of topics 64, 83, 169, 12 estimated from articles in The International New York Times and Financial Times from January 1st, 2009 to December 31st, 2015. Method: LDA via Gibbs Sampling. $K = 200, \alpha = 0.8, Iter = 1000$.

[24] As proposed by *TL Griffiths/ M Steyvers*, Finding Scientific Topics, Proceedings of the National Academy of Sciences of the United States of America, Vol 101, 2004, pp. 5228-5235; See *B. Grün/ K. Hornik*, topicmodels: An R Package for fitting Topic Models, in: Journal of Statistical Software, Vol 40, No. 13, 2011, pp.1-30.

Table 1 represents an excerpt of the matrix β. The topics are lists of terms ordered by probability. In the table, we show the top ten most likely terms in five of the 200 estimated topics. The higher the term's position is on the list, the higher is its probability to appear in the topic. The first column lists the ten most likely terms in "topic 64". The terms stated in this column will likely occur in a document with a high share of the topic that the algorithm has denoted as "topic 64". The top terms constituting this topic are "garden", "tree", "flower", "plant", "mountain", etc. A high share of this topic in a document will likely be related to an article content related to nature or garden. The topic in the second column ("topic 83") comprises the top terms "growth", "economi", "econom", "polici" and "rate". Documents with a high share of this topic will likely have content related to economic conditions.

We search the matrix β for topics that point to terms about the Greek debt crisis. Our finding is "topic 169". We show the top terms in the third column of Table 1. Among the most likely terms are word forms related to Greece, like "greec", "greek" and "countri", as well as financial terms like "imf", "fund" and "financ". Above that, we find crisis words like "bailout". If we proceed further down the word list of this topic (see appendix), we find even more terms that point to "topic 169" being a specific Greek debt crisis topic within our corpus of 432,172 articles from *The International New York Times* and *Financial Times*.

Figure 3: Four exemplary articles with a high share of "topic 169"



Greek debt nightmare laid bare

FT, February 10 2012

A strictly confidential report on Greece's debt projections prepared for eurozone finance ministers reveals Athens' rescue programme is way off track and suggests the Greek government may need another bail-out once a second rescue - set to be agreed on Monday night - runs out.

Hard times ahead, even if Athens gets a deal

International NYT, July 10 2015

Without accord on debt, businesses and society could suffer catastrophe. Businesses and charitable organizations are warning that the social and commercial damage now evident could become deeper and last longer.

Markets steady on Greek lifeline

FT.com, February 11 2012

22:00 GMT: Encouraging economic data from Asia and news of a Germany and France-led rescue package for Greece provided a backbone for markets that initially struggled with but later absorbed plans by the Federal Reserve to rein in its support for the financial system.

Wall Street regained its earlier losses and ended the day little changed as it took in Bernanke's detailed plans, plus the further good news in Europe.

E.U. moves closer to Greek bailout

International NYT, March 04 2010

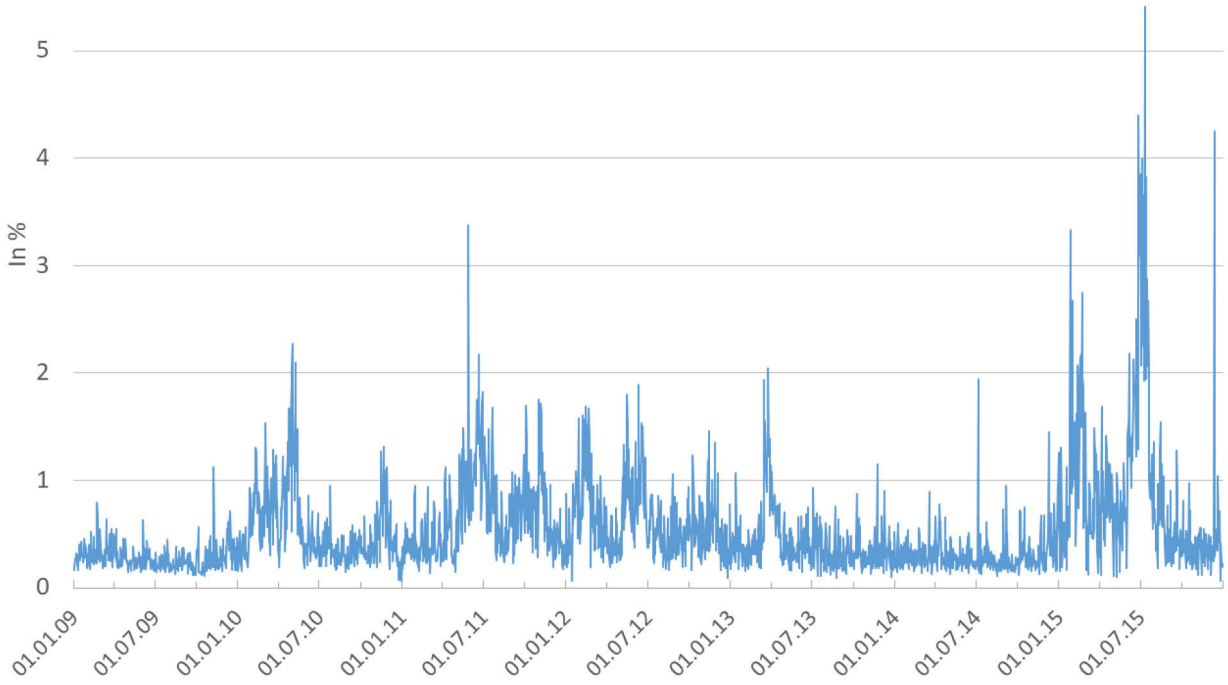
Athens expects support after higher taxes and budget cuts are endorsed The European Commission indicated Wednesday that the way was clear for the first bailout in the history of the euro, if one is needed, after Greece announced fresh austerity measures aimed at generating cash to ease its budget problems.

Beginnings of four exemplary articles with a high share of "topic 169". Articles taken from the Financial Times and The International New York Times. Terms highlighted in gray have a high probability in "topic 169". As comparison, we also show terms with a high probability of "topic 83" highlighted in dark grey.

To check whether "topic 169" points to news coverage about the Greek debt crisis, we next turn to the matrix θ. θ comprises the topic proportions in each document of the corpus. It assigns a probability of each topic to each document. The probabilities of all topics in a document sum up to one. Figure 4 shows the beginning of four exemplary articles with a high share of "topic 169". Clearly, all articles seem to deal with Greece and the Greek debt crisis in particular.

We check more articles with a high share of the topic and conclude that "topic 169" points to an article content dealing with the Greek debt crisis. In the next section, we further verify this finding. For the remainder of this article, we propose "topic 169" as our variable of interest regarding news coverage about the Greek debt crisis. We denote "topic 169" as the "Greek debt crisis topic" and treat it as a proxy for media coverage about the Greek debt crisis in global media.

Figure 5: Greek debt crisis topic - daily average share 2009-2015



Source: Daily average share of the Greek debt crisis topic ("topic 169") in The International New York Times and Financial Times, January 1st, 2009 to December 31st, 2015.

We sum the proportions of the Greek debt crisis topic by date. Figure 5 plots the daily average share of the Greek debt crisis topic in the articles of *The International New York Times* and *Financial Times* over the period from January 1st 2009 to December 31st 2015. As is apparent, the topic has a higher share on some dates and time periods compared with other dates. In 2009, media coverage is low or possibly non-existent. After the new Greek government announced an exorbitant deficit in October 2009 – a point in time that some sources define as the beginning of the crisis – the Greek debt crisis topic increases to high levels in the first half of 2010. We observe many days with a high share of the topic at the height of the crisis between 2010 and mid-2012. After low levels of the topic from mid-2013 to 2014, the topic spikes again between January and July 2015 on many occasions. In this period, the newly-elected SYRIZA government fueled fears of an intensification of the crisis again. The topic seems to spike higher in 2015 than during earlier periods.

In the next section, we relate the Greek debt crisis topic to actual events during the crisis. Accordingly, we further verify that the distribution of the topic constitutes an indicator for news coverage about the debt crisis.

4 News coverage and events in the Greek crisis

Many critical events with relation to the Greek debt crisis remain in our memories; events that substantially and lastingly affected the Greek economy and the Greek reputation on financial markets. The course of events during the crisis was evidently covered in many news outlets and supposedly affected expectations on financial markets.

We use events in two ways: By comparing events and news coverage, we first check whether our proxy for news coverage grasps the events that took place in the course of the Greek debt crisis. We then examine whether news coverage matters for the transmission of events to financial markets. Comparing dates with events and news coverage to dates without events but news coverage, we are potentially able to identify an information effect of the media (information about an event) and a narration effect (narratives about the Greek debt crisis apart from events).

We collect a timeline of events with relation to the Greek debt crisis from the Bank of Greece publication the *Chronicle of the Great Crisis*.[25] The publication contains yearly tables of events with the exact date and a detailed description for the period from 2009 to 2013. In order to fill possible gaps and expand the list of events into 2014 and 2015, we also consider other sources.[26]

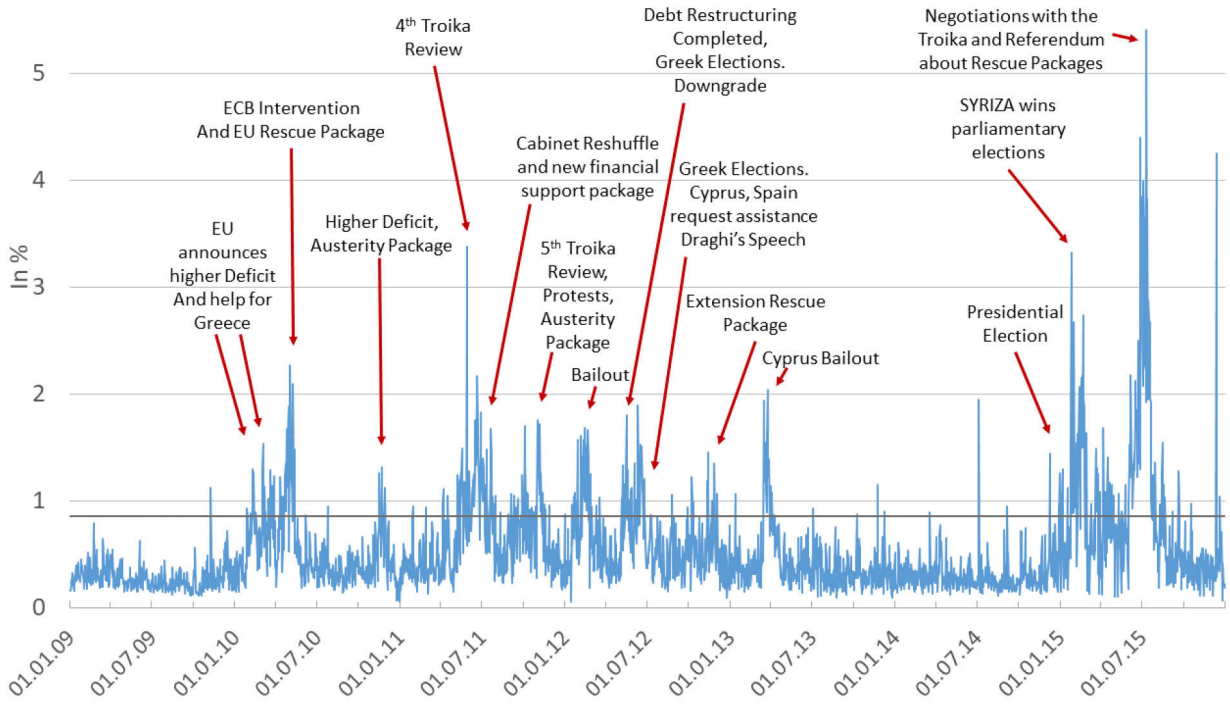
Our series comprises 205 dates that relate to events during the Greek debt crisis. We compare the event series to our proposed proxy for media coverage, namely the Greek debt crisis topic series. We find that the majority of events can be related to increased news coverage around the day of the event. By increased news coverage, we define the 15 percent days with the highest level of the Greek debt crisis topic. We chose 15 percent because it roughly constitutes a one standard deviation above the daily average mean share of the topic. We define an event as covered by the news if we find a date with increased news coverage on the five days before or after the event. As a robustness check, we also test thresholds of 10 percent and 20 percent. For both thresholds as a measure for high media coverage, we still relate the

[25] *Y. Seferlis/ K. Lagaria*, The Chronicle of the Great Crisis: The Bank of Greece 2008-2013: Public Interventions and Institutional Actions to Safeguard Financial Stability and Overcome the Crisis, Bank of Greece, 2014.

[26] We consider the timeline of events in the Greek debt crisis from Reuters (https://www.reuters.com/article/us-eurozone-greece-economy-timeline/timeline-greeces-economic-crisis-idUSTRE62230T20100303, 06.12.2017), Wikipedia (articles on the "Greek government-debt crisis", the "European debt crisis", the "Great recession and 2000s European sovereign debt crisis timeline", and "Anti-austerity movement in Greece") and the German television news service Tagesschau (https://www.tagesschau.de/wirtschaft/griechenland640.html, 06.12.2017).

majority of events to high news coverage. Changing the threshold did not alter the significance levels of the main results in our empirical analysis in the next section.

Figure 6: Events with a high daily share of the Greek debt crisis topic



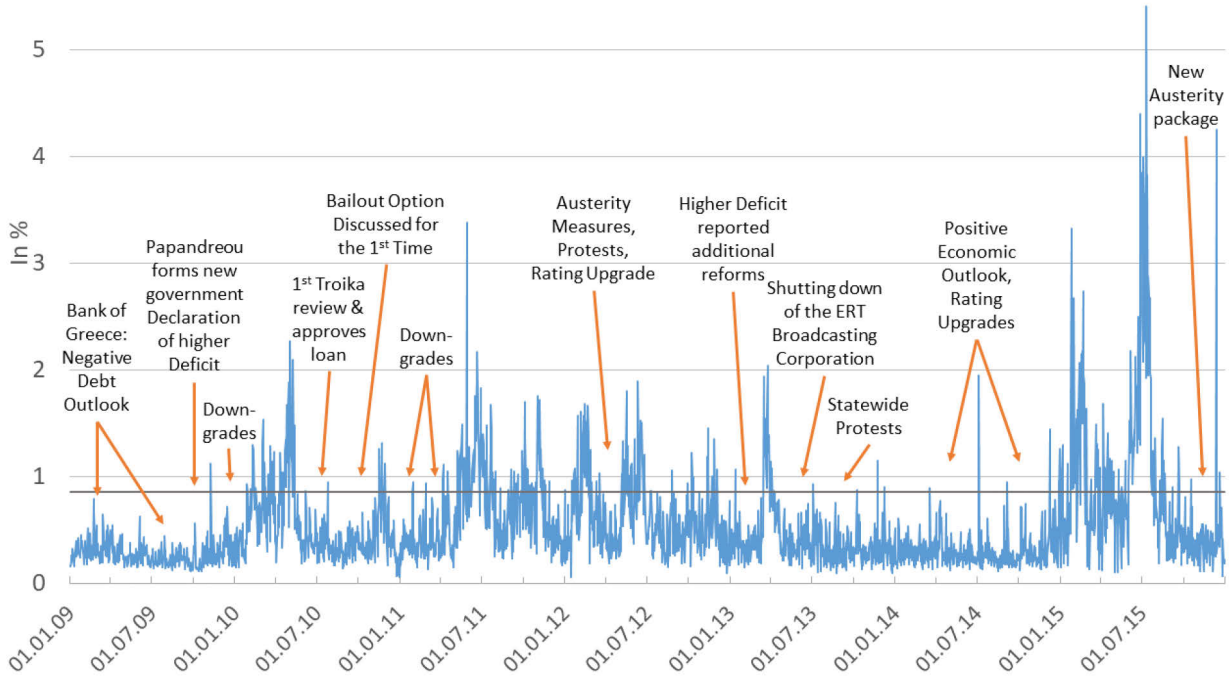
Events as provided by Bank of Greece (2015) and others. Daily average share of the Greek debt crisis topic (topic 169), January 1st, 2009 to December 31st, 2015. Grey vertical line: threshold of days with the highest average share.

In Figure 6, we plot the news coverage and indicate the major events that we are able to relate to increased news coverage. The dark gray vertical line indicates the 15 percent threshold. We define 136 of the 205 events as part of this group. We provide an overview of all events and the classification into sub-groups in the appendix.

We check articles with the highest shares of the Greek debt crisis topic around each date. We find that many events during the crisis are indeed taken up by the global media. The Greek debt crisis topic has a high share in global newspapers around events like the Greek bailouts, negotiations about rescue packages with the so-called *Troika* and Mario Draghi's famous speech in July 2012. This finding underpins our assumption that the Greek debt crisis topic can act as a measure of news coverage. Global media take up

actual events about the Greek debt crisis and utilize vocabulary from the Greek debt crisis topic in those articles. These crucial events remain in the group of events covered by the media when varying our threshold of high media coverage.

Figure 7: Events without a high share of the Greek debt crisis topic

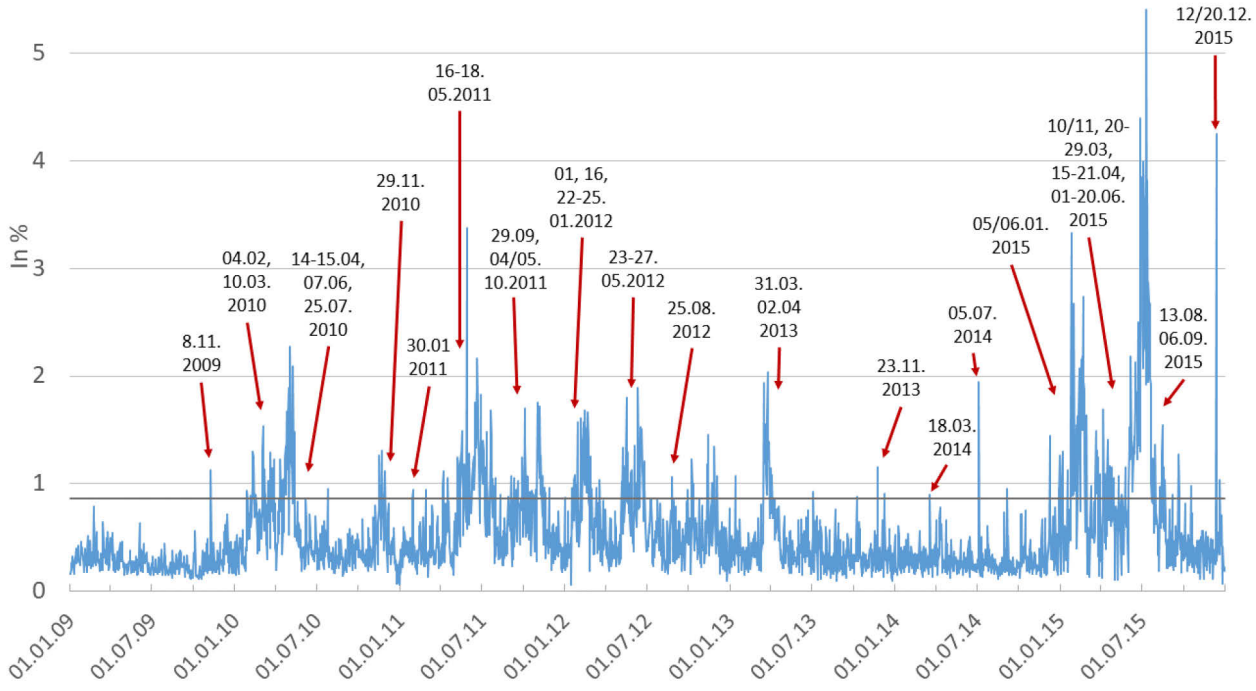


Events as provided by Bank of Greece (2015) and others. Daily average share of the Greek debt crisis topic (topic 169) January 1st, 2009 to December 31st, 2015. Grey vertical line: threshold of days with the highest average share.

From the series of all events, we identify another group of events. Some events do not go along with a high share of the Greek debt crisis topic on the same day, the preceding or following days. Figure 7 indicates the events around which news coverage (e.g. the Greece debt crisis topic) is below the 15 percent threshold of the series. Of the 205 events in our series, we assign 69 events to this group. Among the events in this group, we find reports of the Bank of Greece on the economic and financial outlook of Greece, political events like protests or debates in the Greek parliament. We also find downgrades of Greek government bonds by major rating agencies in this group.

The occurrence of events without news coverage in the global media points to the fact that such events were probably not sufficiently important to make it into news outlets like *The International New York Times* or *Financial Times*. Luhmann's notion of a selection bias of the media provides a possible explanation. Some events were probably not important or informative enough to be covered, while other events were possibly not covered due to the severity of other events and headlines on those dates. By selecting the covered and not covered events, the media influences the set of information available to a global public. Another reason could be that the events were covered but without use of the Greek debt crisis topic. In this case, our measure of news coverage would fail to grasp important information covered in global news about the Greek debt crisis. By comparing the impact of covered and non-covered events in the global media on financial markets, we aim to find an information effect of news. Only events covered should matter for financial markets expectations about Greece.

Figure 8: High daily share of the Greek debt crisis topic without events



Daily average share of the Greek debt crisis topic (topic 169) January 1st, 2009 to December 31st, 2015. Dates indicated are with a high share of the Greek debt crisis topic but without events according to the Bank of Greece (2015) and others. Grey vertical line: threshold of days with the highest average share.

We find a third group of dates that potentially holds information for the analysis of media coverage and financial expectations, namely dates with increased media coverage but without events. In Figure 8, we indicate dates that are among the 15 percent days with the highest news coverage according to the Greek debt crisis topic series but are without an event on the five days before or after that date according to our event series. These days could potentially point to an effect of articles and reports about the Greek debt crisis on financial markets without a "distorting" effect of actual events. News coverage on such dates presumably does not contain new information with respect to the crisis, since no events occur. Therefore, these dates may constitute media reports that affect financial markets via stories and narratives. We may thus find a narration effect about the Greek crisis on such dates.

5 Empirical study - the role of media coverage on financial markets

In order to examine the role of events and media coverage in the Greek debt crisis on financial markets, we collect daily data on the yield to maturity for ten-year Greek government bonds over the period from January 1st, 2009 to December 31st, 2015. We chose the Greek bond yield because it likely reflects actions taken by financial actors with respect to the Greek debt crisis and may thus reflect expectations about the Greek debt crisis on financial markets. For our analysis, we take the logarithm of the series and then transform the bond yield (y_t) into first differences. Accordingly, we define:

$$Y_t = Ln(y_t) - Ln(y_{t-1}) \tag{3}$$

We thereby relate our measures of events and media coverage to daily changes of the bond yield and ensure stationarity of the series. We repeat the following analysis using levels of the Greek interest rate (y_t) instead of changes. The main results are robust to this variation and we provide the results in the appendix.

We aim to observe the extent to which global news coverage and the classified events affect changes in the Greek bond yield as a proxy for financial actors' expectations. We start with the Greece debt crisis topic as our proxy for media coverage and then turn to the events. We also check whether classifying events into favorable and unfavorable news supports our results. We then test the effect of news coverage without events.

5.1 News series

To test whether media coverage has an effect on financial markets, we regress changes in the Greek bond yield (Y_t) on the Greek debt crisis topic (X_t). We add lags of both the topic series (X_{t-1}) and the bond yield series (Y_{t-1}) in the following manner:

$$Y_t = \beta_c + \beta_0 X_t + \beta_1 X_{t-1} + \alpha_1 Y_{t-1} + \varepsilon_t \tag{4}$$

We depict our finding in Table 2. News coverage (X_t) exercises a significant effect on changes in the Greek bond yield on the same day and no effect on the next day. The effect is positive but small on the same day and negative on the next day. This is the case although the lagged changes in the bond yield itself (Y_{t-1}) explain parts of the yield changes in t. The perception about Greece or the Greek debt crisis via the news coverage may thus play a role in financial markets.

Table 2: Regression results news coverage

	Independent Variable: Media coverage (Greek Debt crisis topic)
Dependent Variable: Δ Bond yield	(1)
X	0.01 *
L(X, 1)	-0.005
L(Y, 1)	0.04 *
Constant	-0.0005
Observations	1820
R2	0.003

Results of regressing changes of the Greek bond yield on the daily average share of the Greek debt crisis topic and lags of both series (see Equation (4)). Time period: January 1st, 2009 to December 31st, 2015.

5.2 Event series

Next, we turn to events. We ask whether there is an effect on the Greek bonds yield on the days and the following days after dates in the four series: all events in our series, events with news coverage, events without news coverage and news coverage without events.

In order to answer this question, we regress the changes in the Greek bond yield (Y_t) on dummy series (D_t) for each event class and five lags. We add one lag of the bond yield series:

$$Y_t = \beta_c + \sum_{i=0}^{5} \gamma_i D_{t-i} + \alpha_1 Y_{t-1} + \varepsilon_t \quad (5)$$

We depict our findings in Table 3. Starting with all events in our series, column (1) shows the effect of days with any events concerning the Greek debt crisis and the five following days. We find a weakly significant positive effect on the day of the event and a weakly significant negative effect one day after the event. The other parameters of the events' lags are insignificant.

Table 3: Regression results events

	Independent Variable:			
Dependent Variable: Δ Bondyield	All events (1)	Events and Media (2)	Events, No Media (3)	No Events, but Media (4)
D	0.003 *	0.005	-0.001	0.003
L(D, 1)	-0.01 *	-0.01 **	-0.003	0.0004
L(D, 2)	-0.005	-0.01 **	0.001	0.003
L(D, 3)	0.01	0.01 **	0.001	-0.001
L(D, 4)	-0.001	0	-0.003	0.003
L(D, 5)	0.002	0.003	0.0003	0.001
L(Y, 1)	0.04 *	0.04 *	0.04 *	0.04 *
Constant	0.0005	0.0003	0.0004	0.0001
Observations	1817	1817	1817	1817
R2	0.01	0.01	0.002	0.002

Results of regressing changes of the Greek bond yield on event dummy series and lags of both series (see Equation (5)). Time period: January 1st, 2009 to December 31st, 2015.

We next look at subsets of all events. Column (2) depicts the effect of dates with events that go along with coverage in the global media. Such dates have a significant negative effect on the two days after the event and a positive significant effect three days after the event. Regarding events without news coverage, column (3) reveals that such events appear to have no effect at all on the same day or the five days following. All lags are insignificant.

What about a potential *narrative* effect of news coverage on days without an event? Column (4) shows no effect of days without events but with media coverage about the Greek crisis. Seemingly, news coverage alone has no effect if it is not accompanied by newsworthy events.

In sum, the total series of events appears to have a small effect. While events covered in the news have a stronger effect, events not covered show no effect. Therefore, media coverage seems to matter. However, it matters predominantly in combination with an event, whereas high news coverage alone has no effect. This finding points to the existence of an information effect of media, while there is no evidence of a direct narration effect, which we would expect on days without events. Importantly, we cannot argue that there is no narration effect, since news coverage on days with events could also contribute to the narrative about the crisis. To disentangle both effects should be subject of a careful qualitative examination.

5.3 Favorable and unfavorable Events

From our first set of regressions, news coverage seems to matter for the transmission of events on financial markets. One problem with the significant parameters of the events covered in the media is that they point in differing directions. Therefore, the covered events significantly increase *and* decrease the Greek bond yield. One possible reason for positive and negative coefficients may be that there are favorable and not so favorable news concerning Greece in our set of events.

Therefore, we split our sample into series of positive and negative events. We define positive events as any events that we regard as "good news" for financial investors in Greece. We select solutions to negotiations, agreements and passing of legislations on rescue and austerity measures as part of the positive group. By contrast, we define events as negative if they hamper the future outlook of gains or at least not losses on financial assets in Greece. Other "bad news" for financial investors in Greece are those that raise uncertainty about the future outlook of the Greek economy, bailouts involving private investors and political turmoil. We also include news about higher-than-expected deficits in this group. By this classification, of the 205 events in total, we define 82 events as positive and 67 events as negative. We provide our classification of favorable und unfavorable events in the appendix.

Table 4: Regression results positive and negative events (as compared to all events)

	Independent Variable:		
	All	Positive	Negative
Dependent	Events	Events	Events
Variable: Δ Bondyield	(1)	(2)	(3)
D	0.003	-0.01	0.01 **
L(D, 1)	-0.01 *	-0.02 ***	0.01
L(D, 2)	-0.005	-0.01 ***	0.01 *
L(D, 3)	0.01	0.01 *	-0.003
L(D, 4)	-0.001	0.004	0.001
L(D, 5)	0.002	0.005	-0.0004
L(Y, 1)	0.04 *	0.04	0.04 *
Constant	0.0005	0.001	-0.001
Observations	1817	1817	1817
R2	0.01	0.02	0.01

Results from regressing changes of the Greek bond yield on dummy series of favorable and unfavorable events and lags of both series (see Equation (5)). Time period: January 1st, 2009 to December 31st, 2015.

We run Equation (5) again using the two sub-groups, whereby Table 4 depicts the results. Column (1) shows the baseline case of all – positive and negative – events taken from the previous section. As before, we find no clear effect. By splitting the sample, we observe a more intuitive result. Column (2) shows the effect of positive events. We find a significant negative effect on Greek bond yields on the two days following and no effect on the same day. A significant negative parameter implies a falling bond yield and thus more favorable credit conditions for Greece. This is intuitively correct and explains the significant lagged effect of events on the bond yield. Column (3) depicts the effect of days with negative events. We observe significant positive parameters on the day of such events and two days later. As we would expect, negative events increase the bond yield and worsen Greek credit conditions on the following days.

By splitting our event series into positive and negative events, we obtain reasonable and significant effects of the two sub-groups on changes of Greek bond yields. What about the sub-groups of events with and without coverage? We next multiply each event series by our series of positive and negative events and employ Equation (5) again on the four sub-samples.

Table 5: Regression results positive and negative events with or without news coverage

	Independent Variable:			
	Positive events	Negative events	Positive events	Negative events
Dependent	+ Media	+ Media	No Media	No Media
Variable: Δ Bondyield	(1)	(2)	(3)	(4)
D	-0.002	0.02 **	-0.01	0.01
L(D, 1)	-0.02 ***	0.01	-0.01	-0.0001
L(D, 2)	-0.02 ***	0.01	0.002	0.01
L(D, 3)	0.01 **	-0.004	0.001	-0.003
L(D, 4)	0.01	0.003	-0.001	-0.002
L(D, 5)	0.01	-0.001	0.002	-0.001
L(Y, 1)	0.04	0.04 *	0.04 *	0.04 *
Constant	0.001	-0.0004	0.0005	0.0001
Observations	1817	1817	1817	1817
R2	0.02	0.01	0.004	0.003

Results from regressing changes of the Greek bond yield on sub-series of favorable and unfavorable events and lags of both series (see Equation (5)). Time period: January 1st, 2009 to December 31st, 2015.

Table 5 shows the results for the positive and negative sub-groups. Columns (1) and (2) depict the results for events with news coverage, while columns (3) and (4) depict the results for events without news coverage. According to column (1), the Greek bond yields decline in the two days following a positive event with news coverage (rows 2-3). By contrast, negative events with news coverage (column (2)) significantly increase the bond yield on the day of the event. Turning to events without coverage, Column (3) shows the effect of positive events without news coverage. We find no significant effect for this series. The same is true for negative effects without media coverage (Column (4)). Seemingly, events that do not make it into the editorial boards in London or New York likewise do not make it all the way to Wall Street. Indeed, this appears to be true for both positive and negative events. By contrast, positive and negative events covered in the media significantly transfer into the expected reactions on financial markets.

5.4 News coverage without events

The media may matter for the translation of events into expectations on financial markets, although thus far we find no evidence for a narration effect of news stories on days without events (as indicated in Table 3, column (4)). This is contrary to our second hypothesis that reports about Greece and the Greek debt

crisis may affect financial expectations even without an event. Therefore, we take a closer look at the series of dates with news coverage but without events.

Our guess is that high levels of media coverage about the Greek debt crisis may also point in two directions. Some reports may have a favorable outlook on Greece, while other reports have an unfavorable outlook on Greece. To codify the series, we read the news articles on the days with increased media coverage but without events. On each date, we find articles concerning the Greek debt crisis. We classify the dates into three groups: days with predominantly positive news coverage regarding the Greek debt crisis, days with a negative outlook and the remaining dates without a clear positive or negative outlook.

Table 6: Regression results positive/negative media coverage on dates with no events but with news coverage.

	Independent Variable:			
	Media	Positive Media,	Negative Media,	Neutral Media,
Dependent	No Events	No Events	No Events	No Events
Variable: Δ Bond yield	(1)	(2)	(3)	(4)
D	0.003	0.002	-0.004	-0.01
L(D, 1)	0.0004	-0.001	-0.002	0.003
L(D, 2)	0.003	-0.02	0.004	0.001
L(D, 3)	-0.001	0.01	0.005	-0.01
L(D, 4)	0.003	0.004	0.004	0.01
L(D, 5)	0.001	0.01	0.01	0.005
L(Y, 1)	0.04 *	0.04 *	0.04 *	0.04 *
Constant	0.0001	0.0003	0.0001	0.0003
Observations	1817	1817	1817	1817
R2	0.002	0.002	0.003	0.002

Results of regressing changes of the Greek bond yield on series of dates with high news coverage and favorable or unfavorable news with respect to Greece. We add lags of both series (see Equation 5)). Time period: January 1st, 2009 to December 31st, 2015.

We employ Equation (5) again on each sub-group of days without events, whereby Table 6 depicts the results. Column (1) shows the effect of all dates without events on changes of the Greek bond yield. We find no effect. Columns (2) and (3) show the effect divided by the sub-groups of positive and negative events, respectively. Again, we find no effect. The same is true for dates without a clear positive or negative

outlook (column (4)). In sum, financial markets do not seem to react to media coverage without events, even when focusing on positive or negative reports separately. Accordingly, we find no evidence of a "narration effect".

6 Conclusions

We have studied the effect of events and their coverage in the news about the Greek debt crisis in global media on the expectations of financial actors. In particular, we have tested whether news coverage has an effect on changes of the Greek bond yield depending on whether events were covered in the news. We proposed topic modeling as a novel way to classify news coverage from global newspapers and to construct a quantitative measure of news coverage about the Greek debt crisis.

Our hypothesis was that there is both an information and a narration effect of global media. Events are transmitted to financial markets via the media. Events covered in the media should affect financial markets, while events not covered should have no effect. Beyond events, narration should also matter for financial markets, in the sense that dates with news coverage but without an event have an effect.

Our finding is that events concerning the Greek debt crisis affect financial markets via global news coverage. Events that go along with media coverage affect Greek bond yields on the same day or the days following. This is not the case for events that are not covered. The effect is in the expected direction when we classify positive and negative events. Positive events covered in the news reduce the Greek bond yield while negative events increase the Greek bond yield. For positive or negative events not covered in global news, we find no effect. We conclude that events that appear in the global media also affect financial markets. This finding supports the hypothesis that global media coverage matters in the translation of events on financial markets.

We further tested whether days with high news coverage without events on the same date affected financial markets. We find no evidence that media coverage matters on dates without events. Apparently, solely media reports do not form expectations on financial markets, at least not immediately. This finding is contrary to our second hypothesis that narration matters as much as information.

Our analysis supports Jens Beckert's proposition that fictional expectations are spread via the global mass media to financial markets in the course of the Greek crisis. To be precise, the information function of the media provides occasions for financial markets' participants to update their expectations when events are covered by the media and in anticipation of other actors receiving the same signals via the media. We propose topic models to identify media coverage as a first step to make the transmission of fictional expectations via the media visible. This finding is also in line with Luhmann's supposition that the selection bias of the media influences function systems' and individuals' expectations. However, while the

transmission of events and thus new information via the media seems to matter, we cannot verify a distinct effect of narratives and stories on financial markets. More work is necessary to investigate the transmission mechanism of the media in further detail. In the future, we plan to analyze more specific groups of events and from a more qualitative perspective and relate the results to the quantitative approach used here. By this we expect to further clarify in how far we can disentangle information and narration within articles concerning events. We also intend to focus in more detail on the temporal dimension of changing media coverage in the course of the crisis. Media coverage may create certain narratives that only become relevant when new and important information occurs. This study provides a first step to make visible the mechanism that makes fictional expectations work.

A Appendix

A.1 Words by Topics and Probabilities

Table A.1: Top 20 words in five exemplified topics ranked by probability in each topic

	Topic 64	Topic 169	Topic 83	Topic 27	Topic 12
1	garden *1.87%*	greec *7.17%*	econom *6.46%*	syria *6.11%*	obama *14.84%*
2	tree *1.65%*	greek *5.59%*	economi *5.79%*	syrian *4.05%*	presid *10.39%*
3	mountain *1.49%*	bailout *2.50%*	polici *3.43%*	assad *1.93%*	administr *6.44%*
4	forest *1.09%*	imf *2.38%*	fiscal *2.96%*	regim *1.84%*	white *2.78%*
5	anim *1.07%*	countri *2.23%*	govern *2.59%*	rebel *1.59%*	hous *2.75%*
6	dog *1.02%*	fund *2.10%*	growth *2.39%*	opposit *1.48%*	barack *2.59%*
7	plant *1.02%*	european *2.04%*	countri *2.23%*	govern *1.36%*	american *2.58%*
8	flower *0.98%*	financ *1.99%*	reform *2.07%*	forc *1.26%*	bush *2.35%*
9	bird *0.93%*	govern *1.90%*	deficit *2.03%*	war *1.21%*	washington *2.10%*
10	natur *0.88%*	minist *1.85%*	crisi *1.83%*	lebanon *1.11%*	polici *1.83%*
11	land *0.78%*	intern *1.63%*	economist *1.58%*	conflict *1.10%*	america *1.20%*
12	wild *0.72%*	athen *1.51%*	debt *1.47%*	arm *1.03%*	secretari *1.16%*
13	villag *0.72%*	debt *1.41%*	domest *1.40%*	support *1.00%*	georg *1.07%*
14	park *0.60%*	eurozon *1.39%*	stimulus *1.34%*	weapon *1.00%*	advis *1.05%*
15	river *0.58%*	euro *1.38%*	gdp *1.19%*	intern *0.94%*	nation *0.98%*
16	landscap *0.56%*	offici *1.15%*	monetari *1.05%*	damascus *0.90%*	clinton *0.97%*
17	hill *0.53%*	auster *1.00%*	gross *1.05%*	group *0.85%*	speech *0.90%*
18	winter *0.52%*	monetari *0.93%*	financ *1.01%*	secur *0.79%*	offici *0.84%*
19	place *0.50%*	rescu *0.91%*	product *0.99%*	bashar *0.78%*	congress *0.76%*
20	walk *0.50%*	creditor *0.84%*	financi *0.93%*	fight *0.76%*	polit *0.70%*

Top 20 words with the highest probability for five exemplified topics. We rank each word in each topic by probability. We indicate the probability of each word in the designated topic by the probability in italics below the word. In total, each of the 11847 words in our dataset has a probability in each of the 200 topics.

A.2 Events during the Greek debt crisis 2009-2015

Table A.2: Events during the Greek debt crisis 2009-2015.

Date	Event	Coverage[27]	Meaning[28]
16.02.2009	Bank of Greece Monetary Policy Report 2008-2009: The widening yield spread will entail a higher future burden.	0	-1
15.04.2009	Bank of Greece Annual Report for 2008: Greece must break with the growth model of the past that eventually led to lasting deficits and debts.	0	-1
28.07.2009	Bank of Greece Bulletin of Conjunctural Indicators: Central government deficit in the first half of the year exceeds expectations.	0	-1
04.10.2009	Parliamentary elections are held: PASOK comes out as the leading party and forms a majority government.	0	1
09.10.2009	The Governor of the Bank of Greece meets with the new Finance Minister George Papakonstantinou. They report that the deficit for the first nine months is in the order of 10% and looks set to rise to, if not exceed, 12% by the end of the year .	0	-1
19.10.2009	The European Commission opens an investigation into the reliability of Greek data.	0	-1
22.10.2009	The Greek authorities announce that the 2009 budget deficit is more than double its projection; Rating Fitch: Downgrade	0	-1
08.12.2009	Rating Fitch: Downgrade.	0	-1
16.12.2009	Rating Standard & Poor's: Downgrade.	0	-1
22.12.2009	Rating Moody's: Downgrade.	0	-1
09.02.2010	First austerity package passed in Greek parliament	1	1
11.02.2010	The EU guarantees Greece political support, but no bail-out package.	1	-1
03.03.2010	Second austerity package passed	1	1
22.03.2010	Eurostat announces that the 2009 deficit in Greece is revised to 13.6% of GDP.	1	-1
25.03.2010	Euro area Member States agree to establish a support mechanism for Greece, if the country is shut out of markets.	1	0
09.04.2010	Rating Fitch: Downgrade.	1	-1
22.04.2010	Rating Moody's: Downgrade.	1	-1
23.04.2010	Prime Minister G. Papandreou announces that Greece has officially requested the activation of the support mechanism.	1	0
27.04.2010	Rating S&P: Downgrade	1	-1
02.05.2010	Greek negotiations with the EU and the IMF lead to an agreement on a three-year aid package worth €110 billion.	1	1
03.05.2010	The ECB announces that it will accept Greek government bonds as collateral for its credit operations, regardless of their rating.	1	1

[27] Codifying of the event whether the media coverage on this day is above or below the 15 per cent threshold: above=1, below=0.

[28] Codifying of the event for the Greek government: positive=1, neutral=0, negative=-1.

05.05.2010	Greece wide riots, strikes and demonstrations	1	-1
06.05.2010	Third austerity package passed	1	1
10.05.2010	The ECB decides to conduct interventions in the euro area public and private debt securities. EU and IMF decide a €750 billion package to stabilize the Euro.	1	1
12.05.2010	Greece receives the €5.5 billion by the IMF. Greek trade unions announce general strike.	1	1
18.05.2010	Greece receives the first €14.5 billion tranche by the EU.	1	1
14.06.2010	Rating Fitch: Downgrade	0	-1
05.08.2010	The first review of the Economic Adjustment Program is completed by the European Commission/ECB/IMF (hereinafter the "Troika"). The second instalment amounts to €9 billion.	0	1
19.08.2010	The European Commission approves the second instalment of the loan to Greece.	0	1
10.09.2010	The IMF also approves its €2.57 billion-worth contribution to the second instalment of the financial assistance to Greece.	0	1
18.10.2010	At a meeting between President Sarkozy and Chancellor Merkel, the participation of private creditors in the bailout of distressed euro area countries is suggested for the first time.	0	-1
11.11.2010	Greece fails to hit its austerity targets.	0	-1
15.11.2010	Eurostat announces that the Greek budget deficit in 2009 was higher than assumed.	1	-1
18.11.2010	A more tightening budget proposal is published.	1	0
21.11.2010	Ireland officially requests financial assistance from the EU and the euro area.	1	0
23.11.2010	The Troika approves the disbursement of the third instalment (€9 billion) to Greece.	1	1
15.12.2010	New Austerity law, lead to protests and riots in Greece.	0	-1
16.12.2010	EU Summit. EU Heads of State or Government endorse the establishment of the European Stability Mechanism (ESM).	0	1
14.01.2011	Rating Fitch: Downgrade	0	-1
24.02.2011	Completion of the third review of the financial assistance program by the Troika. Next step the agreement on the fourth instalment amounting to €15 billion.	1	1
07.03.2011	Rating Moody's: Downgrade.	0	-1
29.03.2011	Rating Standard & Poor's: Downgrade.	0	-1
06.04.2011	Portugal is the third euro area country to seek financial aid.	1	0
14.04.2011	In Greece unemployment rises to all-time high.	1	-1
15.04.2011	Prime minister Papandreou announces new austerity package.	1	1
26.04.2011	Greece concedes a higher budget deficit in 2010 than assumed.	0	-1
09.05.2011	Rating Standard & Poor's: Downgrade.	1	-1
20.05.2011	Rating Fitch: Downgrade.	1	-1
27.05.2011	No agreement between the Greek parties about new austerity measures, although the austerity measures are the preconditions for new financial aid by the EU and IMF. Without financial aid Greece is under the threat of default.	1	-1

31.05.2011	The negotiations about a further tranche by the EU are completed. Athens will privatize state properties and lower the sales tax.	1	0
01.06.2011	Rating Moody's: Downgrade.	1	-1
03.06.2011	EU, IMF, and ECB give Greece a good reference. The next €12 billion tranche can be paid out.	1	1
06.06.2011	Greece sells 10 per cent share of telecommunication company OTE to Deutsche Telekom for 400 million Euros.	1	1
08.06.2011	German minister of finance Wolfgang Schäuble demands a second financial aid package and debt restructuring for Greece.	1	0
10.06.2011	The German parliament approves the rescue package for Greece, but under specific conditions.	1	0
13.06.2011	Rating Standard & Poor's: Downgrade.	1	-1
17.06.2011	Portugal's request for financial aid is approved by the European Council.	1	1
20.06.2011	The Eurogroup agrees to define by early July a new financial support package, calling for voluntary private sector involvement.	1	0
21.06.2011	Prime minister Papandreou wins no-confidence vote.	1	1
29.06.2011	Fourth austerity package is passed by Greek parliament. Large two-day demonstrations in front of parliament.	1	1
02.07.2011	The Eurogroup approves the disbursement of the fifth instalment.	1	1
13.07.2011	Rating Fitch : Downgrade.	1	-1
15.07.2011	Publication of results of the EU-wide bank stress testing.	1	0
21.07.2011	The heads of Government of the euro member states agree to support a new program for Greece, amounting to €109 billion, with the voluntary contribution of the private sector.	1	0
25.07.2011	Rating Moody's: Downgrade.	1	-1
27.07.2011	Rating Standard & Poor's: Downgrade.	1	-1
19.08.2011	The Bank of Greece appoints a liquidator at Proton Bank.	0	0
29.08.2011	Alpha Bank and Eurobank announce plans to merge.	1	0
02.09.2011	The negotiations between the Greek government and the Troika reach a deadlock, with the Troika representatives leaving Athens.	1	-1
11.09.2011	New package of measures adopted by the Greek government, including the introduction of a special property tax.	1	1
12.09.2011	The German minister for economic affairs provokes discussions by considering a Greek bankruptcy.	1	-1
19.09.2011	IMF put pressure on Greece for more reforms. Athens signals its willingness to stricter austerity measures in the future.	1	0
21.09.2011	Greece announces officially a further austerity package.	1	0
11.10.2011	Troika pays out the next tranche for Greece.	1	0
20.10.2011	Troika recommends to pay-out the next tranche for Greece. The Greek parliament approves a fifth austerity package.	1	1
21.10.2011	The disbursement of the sixth tranche is endorsed by the euro area finance ministers. A Troika report states that Greece need even more money than estimated(up to 444 billion Euros).	1	-1

26.10.2011	The euro area summit approves a new loan to Greece, amounting to €130 billion, as well as a haircut in Greek debt with private sector involvement (PSI).	1	-1
31.10.2011	Greek Prime Minister Papandreou announces plan for a referendum on the new aid agreement and raises discussions for a vote of confidence in the government. Following his meeting with German Chancellor Merkel and French President Sarkozy in Cannes on 2 November, he calls off the referendum.	1	-1
01.11.2011	Greece's plan for a referendum evokes price drops on stock markets and criticism in Greece. Papandreou's majority in parliament shrinks.	1	-1
03.11.2011	Euro members stop financial aid for Greece and put Papandreou under pressure. In the evening Papandreou announces to give up the referendum.	1	1
05.11.2011	Prime minister Papandreou wins no-confidence vote, but signalizes to pave the way for an interim government.	1	-1
06.11.2011	Papandreou signals to resign. Talks on forming a new government.	1	-1
11.11.2011	An interim coalition government is formed under Lucas Papademos.	1	1
16.11.2011	The Greek parliament elects Papademos as prime minister.	1	1
17.11.2011	A report by the EU task force says, that the Greek government waits for €60 billion outstanding taxes.	1	1
18.11.2011	The new Greek government plans to reduce the budget deficit down to 5.4 per cent.	1	1
23.11.2011	Samaras supports austerity measures after his initial refusal.	1	1
28.11.2011	Greece receives next €8 billion tranche.	1	1
01.12.2011	Large protests against the austerity policies.	1	-1
06.12.2011	Greek parliament votes for radical cuts.	0	0
08.12.1011	ECB announces to support European banks for the next years.	0	1
02.02.2012	Establishment of the European Stability Mechanism (ESM).	1	1
12.02.2012	The Greek Parliament passes a new loan agreement (sixth austerity package) amid violent protests and riots.	1	1
21.02.2012	The Eurogroup endorses a second bailout package for Greece, worth over €130 billion.	1	1
22.02.2012	Rating: Fitch: Downgrade. Greek parliament expects a budget deficit by 6.7 percent in 2012.	1	-1
23.02.2012	The Greek Parliament and Eurozone governments approve the debt restructuring plan under the PSI.	1	-1
24.02.2012	Greek Government blocks bank accounts in foreign countries to fight tax evasion.	1	0
27.02.2012	Rating Standard & Poor's: Downgrade(default-grade)	1	-1
01.03.2012	Decision of the international swaps and derivatives association says that credit default swaps for Greece become invalid in the case of debt waver of private creditors. Euro group paves the way for haircut and financial aid.	1	0
03.03.2012	Rating Moody's: Downgrade (default grade)	1	0

09.03.2012	The restructuring of the Greek sovereign debt under the PSI is successfully completed.	1	1
14.03.2012	Euro area countries approve the second economic adjustment program. The first tranche amounts to €39.4 billion.	1	1
20.03.2012	The Greek parliament votes for second rescue package.	1	1
04.04.2012	Violent protests against the austerity measures	0	-1
02.05.2012	Rating: Standard and Poor's: Upgrade	0	1
06.05.2012	Legislative election. New Democracy (ND) comes first followed by SYRIZA.	1	0
15.05.2012	Last talks about forming a government fail, which leads to new elections in June 2012.	1	-1
16.05.2012	Panagiotis Pikramenos becomes head of an interim government until the new elections.	1	0
17.05.2012	Rating Fitch: Downgrade	1	-1
08.06.2012	Greece announces a drop in GDP by 6.5 per cent.	1	0
17.06.2012	New legislative election. ND comes first followed by SYRIZA.	1	1
20.06.2012	A coalition government is formed by ND, PASOK and DIMAR under Antonios Samaras.	1	1
21.06.2012	Greek government requests for more time to implement austerity measures.	1	0
25.06.2012	Cyprus applies for financial assistance under the EU Support Mechanism. Spain requests financial assistance from euro area Member States for the recapitalization of its banking sector.	1	0
29.06.2012	Euro area summit decision on the establishment of a Single Supervisory Mechanism for banks, with a view to creating a banking union in the euro area.	1	0
01.07.2012	The new Greek government asks to renegotiate the conditions of the rescue package.	1	0
09.07.2012	Prime minister Samaras wins a no-confidence vote in parliament.	1	1
20.07.2012	The ECB stops accepting Greek government bonds as collaterals for repo transactions.	1	0
22.07.2012	German minister for economic affairs casts doubts on Greece to remain in the euro zone. The IMF considers a payment stop as media report.	1	-1
26.07.2012	President Draghi states that the ECB is ready to do whatever it takes to preserve the euro.	1	1
05.08.2012	The Troika is satisfied with the austerity policy.	0	1
07.08.2012	Head of the euro group Jean-Claude Juncker thinks that it would be controllable if Greece leave the euro.	0	0
14.08.2012	Greece gets fresh money on the money market and can therefore serve the ECB repayments.	0	1
06.09.2012	The ECB decides on the modalities for undertaking Outright Monetary Transactions (OMTs) in secondary markets for the purchase of short-term sovereign bonds in the euro area.	0	1
18.09.2012	The Greek minister of finance Stournaras states, that the government cannot hit the deficit target, because the economic performance drops more than expected.	0	0

25.09.2012	Greece announces a budget deficit of €13.5 billion and further financial needs of €15 billion, if the government gets two more years to implement their reforms.	0	0
26.09.2012	General strike interrupts especially the transportation sector.	0	-1
09.10.2012	The IMF does not believe in the schedule of Greek financial recovery. The euro ministers of finance urge Greece to implement reforms.	1	-1
11.10.2012	IMF chief Lagarde proposes more time for Greece to cope with the crisis.	1	0
18.10.2012	General strike hits Greece.	0	-1
24.10.2012	The Greek minister of finance announces delays for implementation of cuts demanded by creditors, the EU commission, ECB and Euro member states.	0	-1
06.11.2012	Another general strike hits Greece.	1	-1
07.11.2012	Seventh austerity package is adopted by Greek parliament.	1	1
12.11.2012	The Greek parliament votes for the budget of the next year. Troika sees progress, but also risks remain.	1	1
13.11.2012	The Eurogroup grants Greece more time to balance its budget, but they reach no agreement about the schedule of repayment and the financing over the next years.	1	0
21.11.2012	Negotiations between ministers of finance of the euro zone and IMF about the next tranche fail and postpone to the next week.	1	-1
26.11.2012	The ministers of finance of the euro zone and IMF agree upon a further rescue package for Greece.	1	1
27.11.2012	The Eurogroup decides to extend the fiscal adjustment program for Greece by two years, to improve lending terms and conditions and to support a debt buyback operation.	1	1
08.12.2012	Greece reports successful repurchase of bonds to reduce the debt by €20 billion.	0	1
10.12.2012	Greece extends the deadline repurchase of bonds.	0	-1
12.12.2012	The Greek program to repurchase yields €31.9 billion offers by creditors.	0	1
13.12.2012	Eurogroup decision on the disbursement of the next instalment exceeding €49 billion.	0	1
14.12.2012	Agreement of the European Council on the establishment of a Single Supervisory Mechanism for banks.	0	1
18.12.2012	Market sentiment on Greece starts to gradually improve. Rating Standard and Poor's: Upgrade.	0	1
01.01.2013	Last-minute agreement reached by US legislative bodies to avert the fiscal cliff.	0	0
12.01.2013	Greek parliament votes for higher taxes.	1	1
21.01.2013	The economic adjustment program for Greece is on a positive track, according to the Eurogroup. An amount of €7.2 billion to cover bank recapitalization and resolution costs is to be paid out.	0	1
04.02.2013	Greece announces a budget deficit of 6.6 percent in 2012, but for the first time it has a primary budget surplus.	0	0

15.03.2013	Cyprus is hit by the crisis. The Eurogroup decides to provide financial assistance of €10 billion to Cyprus.	1	0
19.03.2013	The Cypriot parliament rejects bailout conditions.	1	0
25.03.2013	The Eurogroup reaches a new agreement with Cyprus, which includes an agreement between Cyprus and Greece on the transfer of Greek branches of the Cypriot banks, with a view to protecting the stability of both the Greek and the Cypriot banking systems.	1	1
08.04.2013	The merger of the National Bank of Greece and Eurobank has failed.	1	0
15.04.2013	An agreement is reached following the conclusion of the third review of the Greek economic program by the Troika. The disbursement of a loan tranche of €2.8 billion is announced.	0	1
28.04.2013	Greek parliament approves a new austerity bill.	0	1
03.05.2013	Positive assessment of the Greek program by the IMF.	0	1
13.05.2013	Eurogroup agreement on the disbursement of two sub-tranches, amounting to €7.5 billion.	0	1
14.05.2013	Rating Fitch: Upgrade	0	1
17.05.2013	The EFSF disburses €4,2 billion to Greece.	0	1
11.06.2013	The Greek government shuts down the public broadcaster ERT.	0	-1
17.06.2013	Greek supreme court mandates that the ERT must continue.	0	0
21.06.2013	DIMAR leaves coalition with ND and PASOK.	0	0
25.06.2013	The new government is sworn in, consisting only of ND and PASOK members, after DIMAR has left the coalition.	0	0
08.07.2013	The Eurogroup approves the disbursement of €6.8 billion in tranches under the European Support Mechanism.	0	1
16.07.2013	Greece-wide General strike (for the fourth time this year).	0	0
17.07.2013	Greece government votes for new austerity bill.	0	1
18.07.2013	The German minister of finance visits Athens suggesting to install a growth and development bank.	0	1
24.09.2013	Strikes and protests against austerity measures.	0	0
10.11.2013	A motion of no-confidence filed by opposition party SYRIZA is rejected in the Greek Parliament	0	0
29.11.2013	Rating Moody's: Upgrade.	0	1
8.12.2013	The Greek Parliament passes the State Budget.	1	1
30.03.2014	The Greek parliament passes a new austerity bill necessary for Greece to receive its next bailout payment.	0	1
01.04.2014	Greece receives the next tranche.	0	1
10.04.2014	Greece returns to financial markets	0	1
23.05.2014	Rating Fitch: Upgrade	0	1
09.05.2014	The Greek Parliament approves the Medium-term Fiscal Strategy plan 2015-2018	0	1
09.06.2014	The cabinet is reshuffled. New finance minister.	0	0
08.12.2014	In a first attempt, Greek parliament fails to elect a new president	1	-1
29.12.2014	The election of a new president is failed and leads to new elections.	1	0

25.01.2015	SYRIZA and Alexis Tsipras win the election and built a coalition government with the right wing populist party ANEL.	1	0
28.01.2015	Prime minister Tsipras plans to stop privatizations, reemploy civils servants, raise the minimum wage and minimum pensions and renegotiate the credit conditions.	1	-1
31.01.2015	New Greek government announces to end the cooperation with the Troika.	1	-1
02.02.2015	The Greek minister of finance Varoufakis releases a schedule for a solution of the debt crisis.	1	0
03.02.2015	Varoufakis propose longer maturities and lower interest rates for Greek debt instead of haircut.	1	-1
04.02.2015	ECB does not accept Greek government bonds as collaterals for central bank credits.	1	-1
07.02.2015	Rating Standard & Poor's: Downgrade	1	-1
11.02.2015	No agreement between Varoufakis and ministers of finance of the euro zone about an prolongation of the rescue package.	1	-1
12.02.2015	Greek government misses its budget targets.	1	0
16.02.2015	Meeting of the Eurogroup with Greece leads to no agreement.	1	0
19.02.2015	Greece requests for prolongation of the financial aid by six months.	1	0
20.02.2015	Eurogroup and Greece agree to a four-month prolongation of the financial aid. The Eurogroup demands that Greece presents a list of detailed reforms.	1	1
24.02.2015	The ministers of finance of the eurozone approve prolongation of the financial aid after presentation of the reform list.	1	1
27.02.2015	The German parliament votes for the prolongation of the financial aid.	1	0
27.06.2015	Prime minister Tsipras breaks off negotiations and schedules a referendum on a bailout agreement, to be held on 5 July 2015. This announcement leads to capital controls.	1	-1
05.07.2015	The Greek bailout referendum is held. Over 61% vote to reject the proposed measures by the EU, the ECB and the IMF.	1	-1
11.07.2015	The Greek parliament approves the government proposal about bailout plan.	1	0
12.07.2015	Agreement between the Eurozone heads of government upon negotiations about a third rescue package.	1	1
16.07.2015	The Greek Parliament approves the first round of measures required by the creditors, including changes to pensions and taxes. Violent protests	1	1
20.07.2015	Greek banks open again, but capital controls remain. The Greek government repays two loans to the IMF and ECB.	1	1
23.07.2015	The Greek parliament approves the second set of bailout measures	1	1
03.08.2015	The Greek Stock Exchange reopened after being closed since 25 June and fell more than 16% with bank stocks losing an average of 30% in a single day's trading	1	0
19.08.2015	The ministers of finance of the eurozone approve the third rescue package with a volume of €86 billion.	1	1

20.08.2015	Prime minister Tsipras resigns and announces new election in September.	1	0
24.08.2015	The Chinese stock market crash affects Greece. The Greek Stock Exchange fell 10.54%	1	-1
20.09.2015	SYRIZA wins the Greek parliamentary elections. Tsipras continues its coalition government with ANEL.	1	0
19.11.2015	The government passes a new austerity package.	0	1

Events during the Greek debt crisis 2009-2015. Codifying of the event and media coverage. Is on the day of the event or the five preceding or following days any date among the dates with the 15 percent highest media coverage? above=1, below=0. Codifying of the event as "Good news" or "Bad news" for an investor investing in Greece: positive=1, negative=-1, no classification=0. [29]

[29] Main source of events: *Seferlis/Lagaria*, The Chronicle. We further considered the timeline of events in the Greek debt crisis from Reuters (https://www.reuters.com/article/us-eurozone-greece-economy-timeline/timeline-greeces-economic-crisis-idUSTRE62230T20100303, 06.12.2017), Wikipedia (articles on the "Greek government-debt crisis", the "European debt crisis", the "Great recession and 2000s European sovereign debt crisis timeline", and "Anti-austerity movement in Greece") and the German television news service Tagesschau (https://www.tagesschau.de/wirtschaft/griechenland640.html, 06.12.2017).

A.3 Regression Results using levels of the bond yield as dependent variable

Table A.3.1: Regression results news coverage

Dependent Variable: Bond yield	Independent Variable: Media coverage (Greek Debt crisis topic) (1)
X	0.09
L(X, 1)	0.01
L(Y, 1)	0.99 ***
Constant	0.05
Observations	1820
R2	0.99

Results of regressing the Greek bond yield (levels) on the daily average share of the Greek debt crisis topic and lags of both series (see Equation (4), but using levels instead of changes of the bond yield). Time period: January 1st, 2009 to December 31st, 2015.

Table A.3.2: Regression results events

Dependent Variable: Bond yield	Independent Variable: All events (1)	Events and Media (2)	Events, No Media (3)	No Events, but Media (4)
D	0.14	0.24 **	-0.02	0.14
L(D, 1)	-0.12	-0.18	-0.05	-0.03
L(D, 2)	-0.15 *	-0.28 **	0.02	0.15
L(D, 3)	0.14	0.20 *	0.03	-0.003
L(D, 4)	0.05	0.11	-0.03	0.14
L(D, 5)	0.11	0.19 *	-0.01	0.07
L(Y, 1)	0.99 ***	0.99 ***	0.99 ***	0.99 ***
Constant	0.09 **	0.10 **	0.09 **	0.09 **
Observations	1817	1817	1817	1817
R2	0.99	0.99	0.99	0.99

Results of regressing levels of the Greek bond yield on event dummy series and lags of both series (see Equation (5), but using levels instead of changes of the bond yield). Time period: January 1st, 2009 to December 31st, 2015.

Table A.3.3: Regression results positive and negative events (as compared to all events)

	Independent Variable:		
	All	Positive	Negative
Dependent	Events	Events	Events
Variable: Bond yield	(1)	(2)	(3)
D	0.14	0.05	0.34 **
L(D, 1)	-0.12	-0.49 ***	0.21
L(D, 2)	-0.15 *	-0.51 ***	0.27 **
L(D, 3)	0.14	0.25 **	-0.05
L(D, 4)	0.05	0.01	0.08
L(D, 5)	0.11	0.27 **	0.02
L(Y, 1)	0.99 ***	0.99 ***	0.99 ***
Constant	0.09 **	0.09 **	0.09 **
Observations	1817	1817	1817
R2	0.99	0.99	0.99

Results from regressing levels of the Greek bond yield on dummy series of favorable and unfavorable events and lags of both series (see Equation (5), but using levels instead of changes of the bond yield). Time period: January 1st, 2009 to December 31st, 2015.

Table A.3.4: Regression results positive and negative events with or without news coverage

	Independent Variable:			
	Positive events	Negative events	Positive events	Negative events
Dependent	+ Media	+ Media	No Media	No Media
Variable: Bond yield	(1)	(2)	(3)	(4)
D	0.18	0.55 ***	-0.15	0.05
L(D, 1)	-0.69 ***	0.38 ***	-0.09	-0.01
L(D, 2)	-0.80 ***	0.38 ***	0.05	0.11
L(D, 3)	0.38 ***	-0.11	0.04	-0.002
L(D, 4)	0.03	0.13	-0.01	-0.05
L(D, 5)	0.43	0.05	-0.01	-0.02
L(Y, 1)	0.99 ***	0.99 ***	0.99 ***	0.99 ***
Constant	0.08 **	0.11 ***	0.09 **	0.09 **
Observations	1817	1817	1817	1817
R2	0.99	0.99	0.99	0.99

Results from regressing levels of the Greek bond yield on sub-series of favorable and unfavorable events and lags of both series (see Equation (5), but using levels instead of changes of the bond yield). Time period: January 1st, 2009 to December 31st, 2015.

Table A.3.5: Regression results positive/negative media coverage on dates with no events but with news coverage.

	Independent Variable:			
	Media	Positive Media,	Negative Media,	Neutral Media,
Dependent	No Events	No Events	No Events	No Events
Variable: Bond yield	(1)	(2)	(3)	(4)
D	0.14	-0.01	-0.05	-0.12
L(D, 1)	-0.03	-0.05	-0.0003	0.04
L(D, 2)	0.15	-0.27	0.08	0.03
L(D, 3)	-0.003	-0.02	0.08	-0.1
L(D, 4)	0.14	0.09	0.09	0.09
L(D, 5)	0.07	0.11	0.12	0.09
L(Y, 1)	0.99 ***	0.99 ***	0.99 ***	0.99 ***
Constant	0.09 **	0.09 **	0.09 **	0.09 **
Observations	1817	1817	1817	1817
R2	0.99	0.99	0.99	0.99

Results of regressing changes of the Greek bond yield on series of dates with high news coverage and favorable or unfavorable news with respect to Greece. We add lags of both series (see Equation 5)). Time period: January 1st, 2009 to December 31st, 2015.